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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/039,333	11/09/2001	Gene H. Lee	5545 (2616-012)	1508

32588 7590 05/08/2003

APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER

TRAN, BINH X

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 05/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

AS4

Office Action Summary

Application No.

10/039,333

Applicant(s)

LEE ET AL.

Examiner

Binh X Tran

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 November 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 4-7, 8-9 are rejected under 35 U.S.C. 102(e) as being anticipated by Naeem (US 6,551,942).

Naeem discloses a plasma etching a tungsten-containing layer (22a, 22b) having a patterned hard mask (20a, 20b) comprising:

placing the substrate in a plasma ozone;

introducing into a plasma zone a process gas mix comprising NF₃ and Cl₂ (col. 4 lines 18-34);

forming a plasma from the process gas mix to etch the tungsten containing layer (22a, 22b) substantially anisotropically and at an etch rate greater than the etch rate which the hard mask layer is etch (Fig 1-2).

Respect to claim 4, Naeem discloses the etch profile is vertical (i.e., 90 degree, read on the limitation of "angles of at least about 88 degree with a surface of the substrate", col. 4 lines 40-43, Fig 2). Naeem does not explicitly disclose the etched

features have a critical dimension loss of less than 4%. However, since Naeem teaches the same method claimed using the same material and the same etchant, under the principle of inherency the invention is considered to be anticipated by Naeem.

Respect to claims 5-6, Naeem discloses the ratio of Cl_2/NF_3 ranges from 0.7 to 1.5, preferably from 0.75 to 1.3 (col. 4 lines 25-28, read on applicants' range). Respect to claim 7, Naeem discloses the gas consists essentially of NF_3 and Cl_2 . Respect to claim 8, Naeem disclose the use of passivator gas such as N_2 . Respect to claim 9, Naeem disclose the hard mask layer (20a, 20b) is silicon nitride (col. 3 lines 30-31 and 43-44)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 2-3 rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem.

Naeem does not explicitly disclose the tungsten is etch at an etch rate at least twice or 2.5 greater than the rate of the hard mask is etched. However, Naeem clearly disclose that tungsten etch rate is very high relative to the hard mask (Fig 1-2). Naeem further disclose the selectivity between the tungsten and hard mask (silicon nitride) is a result effective variable by reduce the etch rate of the hard mask (col. 4 line 67 to col. 5 line 1; Note the selectivity of tungsten to hard mask is equivalent to the etch rate of tungsten relative to the etch rate of the hard mask). The result effective variable is

commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention to perform routine experiment to obtain an optimal ratio etch rate between the tungsten and hard mask.

5. Claim 4 is rejected under 35 U.S.C. 102(e) as anticipated by Naeem or, in the alternative, under 35 U.S.C. 103(a) as obvious over Naeem in view of Qian et al. (US 6,136,211).

The 102(e) rejection with respect to claim 4 has been discussed above. Naeem does not explicitly disclose the etched features have a critical dimension loss of less than 4%. In a plasma etching process, Qian discloses that the critical dimension is a result effective variable (col. 4 lines 1-30, Fig 6). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal critical dimension lost as an expected result.

6. Claims 10-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem in view of Qian.

Respect to claim 10, Naeem discloses the step of applying the energy to ionizing the process gas. However, Naeem fails to explicitly disclose applying the RF energy to the inductor coil and the process electrode. Qian disclose the step of applying RF

energy (110, 155) to the inductor coil (115) and process electrodes (120, 125). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Naeem and Qian by applying RF energy to inductor coil and process electrodes because it will directly increase plasma density over the substrate. The limitations of claims 11-18 have been discussed above.

7. Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem and Qian, and further in view of Davis (US 5,164,330).

Respect to claim 19, Naeem and Qian fail to disclose an over etch process mix comprising Ar and Cl₂. However, Naeem clearly disclose the over etch process (col. 4 lines 44-62). In a plasma etching, Davis disclose an over etch process using Ar and Cl₂ (col. 6-7). It would have been obvious to one having ordinary skill in the art, at the time of invention to modify Naeem and Qian by performing an over etch process using Ar and Cl₂ because it will effective remove the tungsten. Further, equivalent and substitution of one for the other would produce an expected result.

The limitations of claims 20-21 have been discussed above.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X Tran whose telephone number is (703) 308-1867. The examiner can normally be reached on Monday-Thursday and every other Friday.

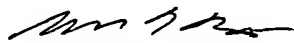
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on (703) 308-3836. The fax phone

Art Unit: 1765

numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Binh X. Tran
May 1, 2003


BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700